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A descriptive analysis of a medical humanitarian aid initiative for quality perinatal management in war-torn Ukraine

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Abstract

Background Russian's invasion of Ukraine has seriously disrupted perinatal care. In a humanitarian initiative, emergency obstetric and neonatal equipment and drugs were provided by Maternal and Childhealth Advocacy International and distributed by Ukrainian partners to a selected 61 maternity hospitals throughout Ukraine. The programme included engaging mothers in labour to undertake fetal heart rate monitoring using a battery operated, portable, doppler ultrasound probe. This paper describes some characteristics of participants and analyses differences in fetal distress management and maternal / neonatal outcomes following different approaches to fetal health surveillance.

Methods Data from 28,808 births were collected in specially developed database which contained information on maternal characteristics, course of pregnancy and childbirth, maternal and neonatal outcomes and donated drugs and equipment used. After informed consent, mothers ($n=13735$) who agreed to use in labour fetal self-monitoring in addition to standard intrapartum fetal health surveillance, monitored and recorded fetal heart rate changes on a "contraction-by-contraction" basis into a special form. Data on maternal experience with self-monitoring were collected. Cases where fetal heart rate changes were identified ($n=1434$) were extracted and analysed for differences in case management and maternal and neonatal outcomes in different approaches: joint monitoring (mother plus staff, $n=901$) vs. staff only monitoring ($n=533$) and different actors in case of joint monitoring (mothers, $n=512$, vs. staff, $n=389$).

Results Vacuum assisted delivery was utilised in only < 2% cases. Caesarean section rate was 27%. Mothers reported their experience with self-monitoring as *great* or *good in 79%*. Preterm deliveries were less frequent where fetal monitoring was provided by both staff and mothers jointly. In the staff plus mother group, more often lateral tilt, intravenous fluid, spontaneous vaginal and vacuum assisted delivery and less often caesarean sections were undertaken even when fetal distress alone was an indication for operative delivery at term pregnancy.

Conclusion Involvement of women may help to make delivery safer for mothers as complications may be recognized earlier and appropriately treated. Overall, the data shows that despite the full-scale war in Ukraine, it remained possible for high quality perinatal health care to continue.

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Keywords Ukraine war, Humanitarian aid, Fetal heart rate monitoring by mothers, Management of fetal distress

Background

Since the Russian invasion of Ukraine, the functioning of maternity and neonatal units has been affected. Shelling of homes and hospitals, large numbers of displaced people including pregnant women, targeted interruptions to electricity supplies, and a shortage of qualified doctors and midwives has greatly affected the provision of quality healthcare. Heightened anxiety among pregnant women in Ukraine, especially if the father of their baby is away fighting to protect the country, is also an important issue that may negatively impact on their health, especially around the time of labour and delivery.

The implementation of normal care and management protocols for providing care for pregnant women during labour and for their newborn infants [1] may not always be possible. For example, the Ukrainian national protocol which is in line with WHO recommendations [2], endorses fetal heart rate (FHR) monitoring during labour and delivery to help reduce intrapartum complications such as stillbirth and perinatal asphyxia (leading to neonatal deaths or long-term disability) may be difficult to follow if there is missile attack and staff, along with women in labour, need to move to a bomb shelter.

The existing national intrapartum FHR monitoring protocol in Ukraine is based on NICE guidelines (NICE CG 190) [3] and followed WHO recommendations [4] namely that FHR auscultation be undertaken for at least 60 s after a palpated contraction during the latent and active phases of first stage of labour every 30 and 15 min respectively and during the second stage of labour every 5 min or after every contraction. Intrapartum monitoring is undertaken by local staff (intermittent auscultation using a Pinard stethoscope or hand-held Doppler device). Obstetricians and midwives are always present at all deliveries. It is not standard practice in Ukrainian maternity units to use cardiotocography (CTG) in a continuous recording mode for long periods of labour and delivery but rather for short recording periods (around 20–40 min) or only in the audio mode if intermittent auscultation monitoring indicated a potential FHR problem. Fetal scalp electrodes are not used in Ukraine. In cases where FHR changes are confirmed by suspicious or pathological FHR features on CTG trace, fetal distress diagnosis is based on the visual interpretation of cardiotocograph records and clinical data. There is no option in Ukraine to collect fetal blood sampling, even this is recommended in the national protocol [1]. The management includes standard actions for fetal distress, namely, a systematic assessment of the condition of the woman and unborn baby and vaginal examination where appropriate. If fetal distress is identified, lateral tilt, intravenous fluids, cessation of oxytocin infusion and possible tocolytic drugs [1] are also undertaken. When a specific obstetric problem, such as obstructed or prolonged labour, placental abruption or previa, cord prolapse, severe preeclampsia or chorioamnionitis are identified appropriate management for this condition is immediately undertaken. Delivery either by vaginal assisted delivery (with vacuum or forceps) or by Caesarean section are undertaken in as timely a manner as possible and when appropriate.

The National Health Service in Ukraine are government funded and well organised. Before commencing our initiative, analysis of comprehensive maternal and neonatal data provided to us by partner-maternity hospitals, showed possible ways in which to help mitigate the effects of the war on the quality of perinatal care.

With support from the Ministry of Health of Ukraine, from the Association of Obstetricians and Gynaecologists, and the Association of Neonatologists in Ukraine we implemented a programme with the aim of maintaining the quality of perinatal care in 61 maternity hospitals throughout Ukraine.

Our programme included engaging mothers (and partners when present) in labour to undertake FHR self-monitoring. This approach has been successfully implemented in Liberia, a low-income country with a shortage of midwives and doctors, helping to prevent long-term disability by reducing birth asphyxia [5, 6]. In Ukraine additional FHR monitoring by mothers was implemented to supplement the existing system of intrapartum fetal health surveillance, mainly monitoring of fetal heart rate by medical staff. This approach encouraged mothers and their partners to active participation by giving them some control and reassurance during labour by involving them in assisting staff to monitor for fetal distress, a situation of great relevance to Ukraine.

The aim of this paper is (1) to present some characteristics of the programme participants reported in the database during 1st February – 1st October 2023, including mothers' experiences with self-monitoring of FHR changes following the end of every uterine contraction ("contraction-by-contraction") during labour, and (2) to analyse if there is any differences in FHR changes (fetal distress) management and maternal / neonatal outcomes in different approaches (joint monitoring (mother plus staff) vs. staff only monitoring) and different actors in case of joint monitoring (mothers vs. staff) for fetal health surveillance. FHR changes immediately after each contraction were recorded because such changes are more likely to indicate possible fetal distress.

Methods

Each hospital's clinical director was contacted and a total of 61 maternity hospitals identified to enrol in the programme. All hospitals participating in the programme signed letters of request to Maternal and Child Advocacy International (MCAI) to provide humanitarian aid which included equipment, drugs and supplies crucial to maintain high standards of maternal care and help to prevent damage to babies caused by hypoxia during delivery. After receiving information from these hospitals, we provided essential, high quality emergency equipment, drugs and supplies [7–9] that were distributed by a local non-governmental organization to each of 61 maternity hospitals throughout Ukraine in 3 consignments between November 2022 and March 2023 (see Supplemental Files 1 and 2). At handover, collaboration agreements were signed and exchanged between MCAI and each of the 61 hospitals. These agreements denoted the responsibility of each hospital to use the donated supplies and equipment to benefit patients attending their hospitals, to inform patients admitted about the programme aiming to provide quality improvement actions to enhance existing obstetric management in the prevention of birth asphyxia, to enrol participants in the programme, and to collect anonymised data for the programme monitoring and reporting.

On admission to the hospital, women were informed about the programme and invited by the staff on duty to participate in the fetal self-monitoring component. That was the only the way to invite participants to the programme during the war period as very often, and up to the beginning of delivery, women may not know exactly which hospital they can reach and if this hospital is among those participating in the programme and providing opportunity for "contraction-by-contraction" self-monitoring. Moreover, additional visits or time spent for recruiting and training in fetal heart rate self-monitoring at the antenatal clinics could increase mothers' risks for life because of frequent drone and missile attacks in the country and was considered not ethical.

In each hospital, following informed consent and training on admission in labour, mothers were provided with a battery-operated FHR doppler ultrasound probe (provided as a part of humanitarian assistance) to enable them to identify changes in fetal heart rate on a "contraction-by-contraction" basis immediately following the end of every uterine contraction for approximately 30–60 s in labour alongside existing monitoring undertaken by local staff. Women could opt in or out from the programme at any time they wished.

Training was provided to mothers who agreed to participate (and birthing partner if present) in the use of the doppler probes, enabling her/them to identify faster or slower heart rate changes after the current contraction in comparison to the FHR they had heard after the previous contraction Mothers were not asked to identify abnormal numeric values of the FHR (the latter was undertaken by staff). Mothers were asked to record their findings on a self-monitoring form in the Ukrainian language (Fig. 1). When mothers identified faster or slower fetal heart rates, medical staff were called immediately and after the next contraction FHR was undertaken by the staff. If FHR changes were confirmed, appropriate actions, according to the national protocol, would be undertaken.

The third column reports the confirmation or otherwise by medical staff of any changes identified by the mother/partner along with the time of their evaluation. The presence of meconium indicating further possible evidence of fetal distress was recorded. Finally, actions taken for confirmed changes in FHR by staff were documented on the bottom of the chart.

Women who agreed to be part of the fetal self-monitoring component of the programme, those who had signed informed consent on paper, and completed the mother's fetal heart rate "contraction-by-contraction" self-monitoring form during delivery, were asked to evaluate self-monitoring by classifying their experience as "great, good, acceptable, bad or very bad" (on paper).

Data were collected in each hospital on as many cases as it was possible in the current situation both among those women who monitored FHR themselves and those who did not. Data were entered on computer pads provided by the project into a database (Memento) developed in the Ukrainian language which could allow upload of data on and off the internet.

Only anonymised data were entered into database. Hospital case record numbers were used by hospital staff who entered these data to keep a link to patients in case clarification was needed.

Clinical data were collected on maternal age, presence of partners during delivery, displacement as result of war, obstetrical history, duration of pregnancy, fetal position, multiple pregnancy, history of previous caesarean section or uterine surgery.

Maternal diseases were reported as chronic hypertension, chronic renal diseases, decompensated heart diseases, urinary tract infections, diabetes mellitus/gestational diabetes, acute respiratory distress syndrome at the delivery time, and trauma at the time of admission.

Information on some obstetric complications during pregnancy or childbirth was collected and included: placenta praevia, placental abruption, uterine rupture, premature rupture of membranes for more than 24 h, chorioamnionitis, severe preeclampsia / eclampsia, intrauterine fetal growth restriction, prolonged labour, obstructed labour, fetal distress, shoulder dystocia, cord prolapse, postpartum haemorrhage (PPH) 500–1000 ml, and PPH > 1000 ml.

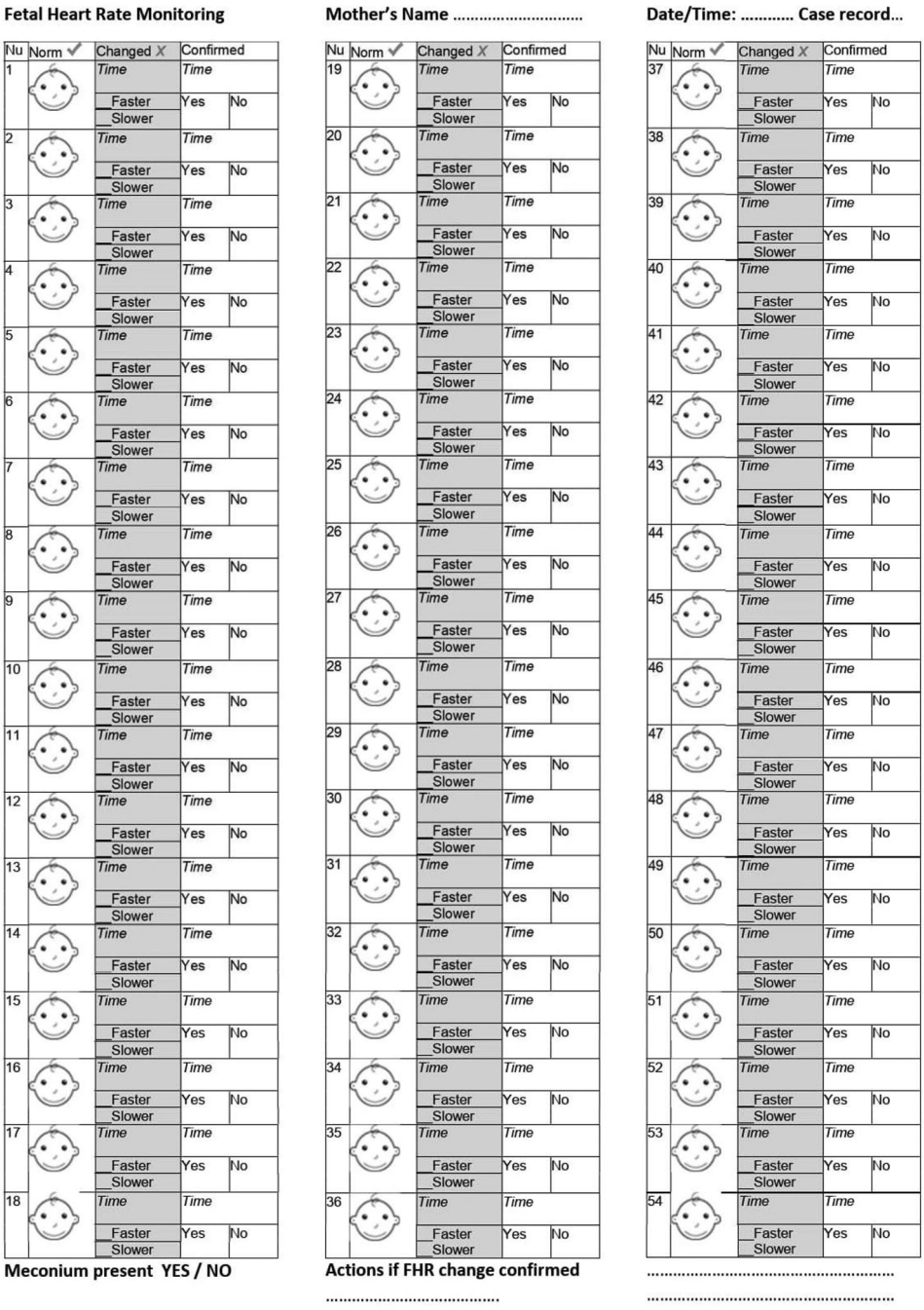

Fig. 1 Self-monitoring form to report fetal-heart rate changes by mothers and/or their partners (English translation). The smiling faces on the form were ticked by the mother/partner if there is no change in the fetal heart rate in the 30–60 s period immediately following the end of each uterine contraction. When, and if, there was a change in fetal heart rate, time was recorded and a cross was placed on either 'faster' or 'slower' rate and medical staff were contacted

Sets of data were collected on FHR monitoring by medical personnel and by mothers where applicable. Actions taken in case of changes in FHR (fetal distress) were reported.

Data were entered on the course and outcome of delivery for both mother and neonate, including methods of delivery, Apgar score at first and fifth minute, resuscitation, admission to neonatal intensive care unit, hypoxic-ischemic encephalopathy, seizures, transfer, perinatal death and cause of death.

Part of the monitoring form included information on any donated equipment used.

Information from mother's FHR monitoring forms, as well as on maternal experience with self-monitoring, were entered in the Memento database.

Staff from each hospital regularly uploaded data to the cloud which were then analysed sequentially. Only anonymised data were analysed.

The total database was used to analyse some characteristics of the entire population.

To analyse differences in fetal distress case management, all cases where FHR changes were identified either by mother or by medical personnel were extracted and analysed separately.

Cases selected and logic for subsequent analyses is presented in Fig. 2.

The lower panel indicates initially the Types of Delivery undertaken; vaginal, forceps assisted, vacuum assisted, and Caesarean section, and underneath the neonatal outcomes recorded in terms of resuscitation at birth, Apgar scores, Neonatal Unit admission, Hypoxic Ischaemic Encephalopathy, presence of seizures, early neonatal deaths and stillbirths.

All variables were categorized as a dummy variable (yes/no). Statistical analyses were performed using EZR v.1.54 (open access software). In the univariate analyses, chi-square tests were used. A p = value less than 0.05 was considered statistically significant.

Approval to participate in the programme and collect data was undertaken by an authorized person in each of the 61 participating hospitals. Before any work was undertaken, the programme was approved by The Ministry of Health Ukraine and Ukrainian Association of Neonatologists and Association of Obstetricians and Gynaecologists.

Results

Participating hospitals and use of donated equipment

Participating hospitals were located in 16 regions of Ukraine (Fig. 3). Nineteen of the 61 hospitals (31%) were situated in areas under constant attacks from Russian military especially to civilian areas, hospitals and electrical and other power generators.

All 61 hospitals regularly entered data into their computer pads for upload to the Memento database cloud for analysis. Because of frequency of military attacks, 3 of those 19 hospitals in high-risk areas provided less data than usually would be possible.

Supplemental File 2 describes the reported use of donations by the 61 hospitals.

Some characteristics of the project participants and their experience with self-monitoring of fetal heart rate (FHR) "contraction-by-contraction" during delivery as entered in the database

Data were provided for 22,808 deliveries and corresponding 23,052 neonates between February and October 2023. Table 1 summarises selected data on mothers and neonates collected in the Memento database by 61 hospitals.

Around 6% of families reported to be internally displaced because of the war.

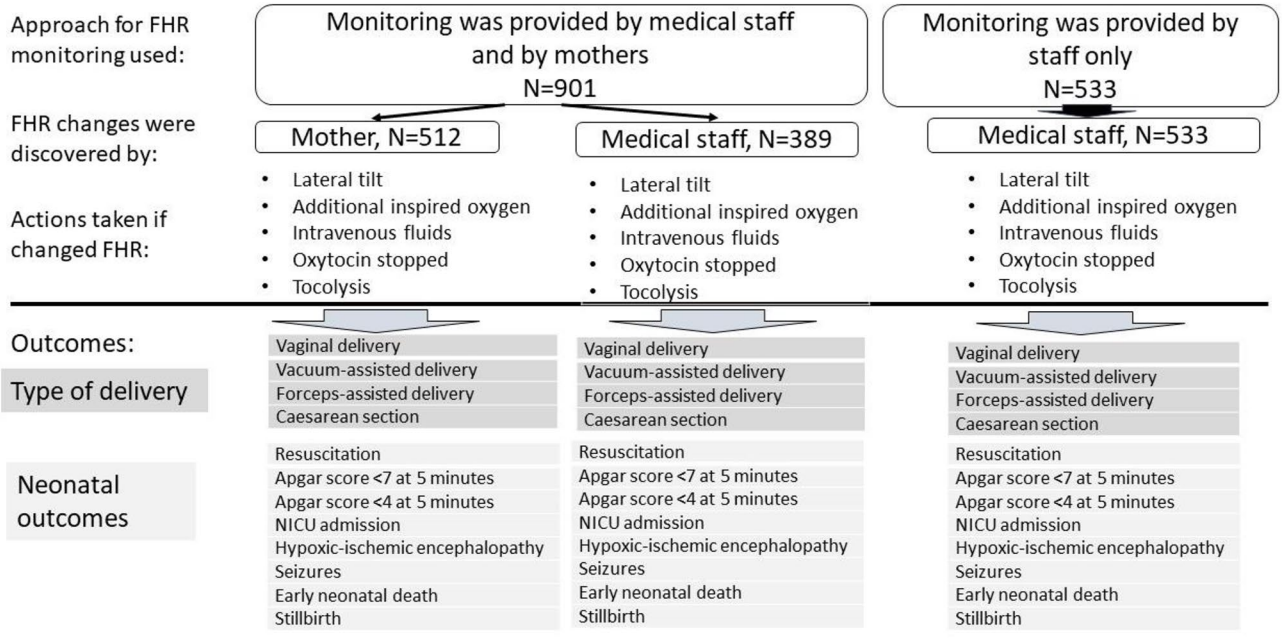

Fig. 2 Flow chart for interventions and outcomes. The upper panel includes details of the three groups with respect to who undertook the fetal heart rate monitoring, the changes identified in fetal heart rate, and which group identified them, and the actions taken to manage patients with any relevant medical or delivery problems and any changes identified and confirmed by medical staff

Fig. 3 Distribution of humanitarian consignments by Maternal and Childhealth Advocacy International in 16 regions of Ukraine. Circles concerning the timing of each consignment are: grey – first consignment, black – second consignment, white – third consignment

69% of women in the program population were accompanied by their partners during labour and delivery.

Around 8% of women had a uterine scar following previous Caesarean section or gynaecological surgery.

In 60 cases trauma/injuries were reported, constituting 0.3% of women in labour.

Caesarean section rate was around 27% and assisted vaginal delivery was around 2%.

Around 6% of neonates were preterm with around 22% of them delivered at 32 gestational weeks or less.

In total, around 2% of neonates required resuscitation and around 1% had Apgar scores lower than 7 at 5 min after the birth.

Around 3% of neonates were admitted to a neonatal unit; 0.2% had hypoxic ischaemic encephalopathy and less than 0.1% developed seizures.

Perinatal mortality rate was 2.72 per 1000 deliveries among included babies, with a substantial proportion of stillbirths (85%).

No maternal deaths were reported in this database.

Totally, fetal heart rate changes were identified in 1434 mothers (around 6% of deliveries reported in the database) and managed as fetal distress. Clinical actions applied are reported in the Table 2.

60% ($n = 13735$) of women reported in the database participated in FHR self-monitoring. They reported 3.7% of FHR changes, and 87% of their particular cases were confirmed by staff.

Only around 2.6% of mothers reported bad or very bad experiences with FHR self-monitoring (Table 3).

Fetal heart rate changes (fetal distress) management and maternal / neonatal outcomes of cases where FHR changes were identified either by mother or by staff among those where mothers were and were not involved in FHR monitoring

Of the 22,808 deliveries in the database, there were 13,735 (60%) reports on the delivery where the mother had used self-monitoring in addition to the fetal surveillance provide by staff and 9055 reports when only staff had monitored FHR.

Among those where additional monitoring was provided by mothers, there were 512 cases (3.72%) where, on a "contraction-by-contraction" basis, a mother, with or without help from her partner, identified changes in her fetal heart rate. 383 (74.8%) reported slowing and 105 (20.5%) reported quickening of their fetal heart rates. In 24 (4.7%) the type of changes in FHR were not clarified. FHR changes reported by mothers were confirmed in 447 of these 512 cases (87.3%) by staff (including in most by CTG).

In the second group where mothers were monitoring but did not identify changes in FHR, 389 FHR changes (2.8%) were identified by medical staff.

In total, among those women who been involved with staff in the monitoring of their unborn babies, changes in FHR were identified in 901 cases (6.6%).

Table 1 Selected characteristics of the programme population entered into the database by 61 maternity hospitals

	Characteristics	Number	%
Mothers' information		***n* = 22,808**	
	Partners attending delivery	15,649	68.61
	Internally displaced by the war	1478	6.48
	Method of delivery		
	Vaginal delivery	15,527	68.08
	Vacuum-assisted delivery	412	1.81
	Forceps-assisted delivery	11	0.05
	Caesarean section	6,114	26.81
	Not recorded	744	3.26
	Maternal diseases		
	Gestational diabetes	283	1.24
	Diabetes mellitus	52	0.23
	Urinary tract infection	531	2.33
	Chronic hypertension	577	2.53
	Chronic kidney disease	422	1.85
	Heart disease decompensated	57	0.25
	Acute respiratory distress syndrome	38	0.17
	Trauma / injuries	60	0.26
	Pregnancy events		
	Breech presentation	703	3.08
	Transverse position	138	0.61
	Multiple pregnancy	244	1.07
	Scar from previous Caesarean section	1796	7.87
	Scar from other previous uterine operation	71	0.31
	Preterm labour (< 37 weeks)	1209	5.30
	Preterm labour (33–36 weeks)	926	4.06
	Preterm labour (28–32 weeks)	221	1.00
	Preterm labour (< 28 weeks)	62	0.27
	Pregnancy and delivery complications		
	Placenta praevia	88	0.39
	Placenta abruption	220	1.0
	Intrauterine fetal growth retardation	163	0.71
	Eclampsia	3	0.01
	Severe preeclampsia	194	0.85
	Rupture of membranes > 24 h	541	2.37
	Chorioamnionitis	58	0.25
	Hypotension sudden	26	0.11
	Umbilical cord prolapse	46	0.20
	Prolonged labour	1010	4.43
	Obstructed labour	518	2.27
	Shoulder dystocia	40	0.18
	Uterine rupture	2	0.01
	Post-partum haemorrhage 500–1000 ml	163	0.71
	Post-partum haemorrhage > 1000 ml	55	0.24
Neonatal information		*n* = 23,052	
	Preterm birth (< 37 weeks)	1338	5.80
	Preterm birth (33–36 weeks)	1039	4.51
	Preterm birth (28–32 weeks)	237	1.03
	Preterm birth (< 28 weeks)	62	0.27
	Low birth weight (< 2500 g)	1331	5.77
	Receiving resuscitation	492	2.13
	Apgar < 4 at 5 min	21	0.09
	Apgar < 7 at 5 min	237	1.03

Table 1 (continued)

	Characteristics	Number	%
Mothers' information		***n* = 22,808**	
	NICU admissions	794	3.44
	Birth asphyxia markers		
	Hypoxic ischaemic encephalopathy	48	0.21
	Seizures	17	0.07
	Stillbirths	53	0.23
	Early neonatal death (per 100 livebirths)	9	0.04

Table 2 Fetal heart rate (FHR) monitoring results in the total database, *n* = 22,808

Indices	Number	%
Number of cases where mothers providing FHR rhythm self-monitoring	13,735	60.22
Number of changes in FHR rhythm identified by mothers	512	3.72
Number of cases where changes in FHR rhythm identified by mothers were confirmed by staff	447 (of 512)	87.30*
Total number of cases where FHR changes were identified either by mothers or by staff	1434	6.29
Actions for FHR changes identified by mothers or by staff (*n* = 1434) and managed as fetal distress (more than one action can be applied in each mother).		
Lateral tilt for FHR change	635	44.28
Additional inspired oxygen	125	8.72
Intravenous fluids	230	16.04
Oxytocin stopped	102	7.11
Tocolysis	2	0.14
Vacuum-assisted delivery	281	19.60
Forceps-assisted delivery	11	0.77
Caesarean Section	922	64.3

* - denominator is number of mothers who identified changes in FHR during self-monitoring

Table 3 Maternal experience with fetal heart rate self-monitoring

Maternal experience with self-monitoring FHR	Number of cases *N* = 13,735	%
Number of mothers who provided their views on fetal self-monitoring	12,362	90.0
Maternal experience with self-monitoring (*n* = 12362):		
Great	3294	26.65
Good	6474	52.37
Acceptable	2271	18.37
Bad	235	1.90
Very bad	88	0.71

In the group where intrapartum fetal heart rate monitoring was undertaken only by the medical staff, 533 cases with FHR changes were recognized (5.9%).

Data on maternal diseases, pregnancy events, pregnancy and delivery complications and postnatal events are presented in the Table 4.

Comparisons between mothers first identifying FHR changes and where staff plus mothers were monitoring and staff first identified FHR changes (columns 2 versus 3)

Situations where FHR changes were initially recognized by mothers compared with those first recognised by staff during maternal monitoring demonstrated lateral tilt and additional inspired oxygen usage more often. Vaginal deliveries in mothers first identifying FHR changes were more frequent and Apgar scores less than 7 at five minutes were less frequent.

Comparisons between cases where mothers plus staff were jointly monitoring and where staff alone were monitoring (columns 4 versus 5)

Among those cases with FHR changes monitored and identified only by the staff, chronic hypertension, intrauterine growth restriction and placenta abruption were more often than among those cases where mothers participated jointly with staff in the fetal monitoring. In this group breech presentation was more often and five mothers had transverse position of the fetus. Preterm deliveries were more often observed among reported cases of FHR changes in the staff only group than in the jointly monitoring group.

In the group where both mothers and medical staff were jointly monitoring as compared with those where only staff were monitoring, lateral tilt, additional inspired oxygen, intravenous fluids were more often undertaken. Vaginal deliveries and vacuum assisted deliveries were more often and Caesarean section was less often than in the group with only medical staff monitoring.

Table 4 Some characteristics, actions taken, and outcomes for mothers and neonates when FHR changes were identified

Characteristics	FHR changes were identified in the database (*n* = 1434)					
	Monitoring was provided by medical staff and by mothers *N* = 901			Monitoring was provided by staff only *N* = 533	*P value for columns* 2–3	*P Value for columns* 4–5
	FHR changes detected by mothers *n* = 512 (%)	FHR changes detected by staff but not detected by mothers *n* = 389 (%)	Total FHR changes detected by mothers and by staff *n* = 901 (%)	FHR changes detected by staff *n* = 533 (%)		
1	2	3	4	5	6	7
Maternal diseases						
Diabetes mellitus + gestational diabetes	10 (1.95)	4 (1.03)	14 (1.55)	9 (1.69)	0.297	0.826
Chronic hypertension	16 (3.13)	12 (3.08)	28 (3.11)	28 (5.25)	0.875	0.038
Chronic kidney diseases	14 (2.73)	5 (1.29)	19 (2.11)	11 (2.06)	0.156	0.928
Acute respiratory distress syndrome	3 (0.59)	7 (1.80)	10 (1.11)	9 (1.69)	0.074	0.333
Heart disease decompensated	2 (0.39)	1 (0.26)	3 (0.33)	3 (0.56)	0.755	0.598
Pregnancy events						
Breech presentation	7 (1.37)	4 (1.03)	11 (1.22)	16 (3.00)	0.693	0.020
Transverse position	0 (0)	0 (0)	0 (0)	5 (0.90)	-	<0.01
Multiple pregnancy	3 (0.59)	7 (1.80)	10 (1.11)	8 (1.50)	0.074	0.666
Scar after previous caesarean section	12 (2.34)	6 (1.54)	18 (2.08)	8 (1.50)	0.441	0.508
Intrauterine fetal growth restriction	7 (1.37)	5 (1.29)	12 (1.33)	17 (3.19)	0.969	0.020
Pregnancy and delivery complications						
Rupture of membranes > 24 h	14 (2.73)	14 (3.59)	28 (3.11)	23 (4.32)	0.526	0.261
Chorioamnionitis	6 (1.17)	4 (1.03)	10 (1.10)	4 (0.75)	0.887	0.401
Placenta previa	1 (0.19)	2 (0.51)	3 (0.33)	0 (0)	0.39	0.161
Placenta abruption	9 (1.76)	6 (1.54)	15 (1.66)	31 (5.82)	0.861	<0.001
Preeclampsia severe + eclampsia	3 (0.59)	7 (1.80)	10 (1.11)	11 (2.06)	0.074	0.146
Prolonged labour	36 (7.03)	39 (10.03)	75 (8.32)	36 (6.75)	0.099	0.269
Obstructed labour	13 (2.54)	12 (3.08)	25 (2.77)	9 (1.69)	0.716	0.223
Cord prolapse	3 (0.59)	3 (0.77)	6 (0.67)	8 (1.50)	0.698	0.174
Shoulder dystocia	1 (0.19)	4 (1.03)	5 (0.55)	1 (0.19)	0.087	0.251
Preterm delivery	27 (5.27)	26 (6.68)	53 (5.88)	67 (12.57)	0.388	<0.001
Delivery details						
Vaginal deliveries	121 (23.63)	56 (14.40)	177 (19.64)	42 (7.88)	0.001	<0.001
Vacuum-assisted deliveries	100 (19.53)	118 (30.33)	218 (24.20)	63 (11.82)	<0.001	<0.001
Forceps-assisted deliveries	4 (0.78)	7 (1.80)	11 (1.22)	0 (0)	0.025	0.026
Operative vaginal birth (vacuum + forceps) purely for fetal distress	80 (15.63)	91 (23.39)	171 (18.98)	51 (9.57)	0.003	<0.001
Caesarean section	286 (55.66)	208 (53.47)	494 (54.83)	428 (80.30)	0.518	<0.001
Caesarean section purely for fetal distress	190 (37.11)	123 (31.62)	313 (34.74)	269 (50.47)	0.087	<0.001
FHR changes were confirmed by staff / and/or CTG	447 (87.30)	389 (100)	836 (92.79)	533 (100)	-	-
Actions for changes in FHR						

Table 4 (continued)

Characteristics	FHR changes were identified in the database (*n* = 1434)					
	Monitoring was provided by medical staff and by mothers *N* = 901			Monitoring was provided by staff only *N* = 533	*P value for columns* 2–3	*P Value for columns* 4–5
	FHR changes detected by mothers *n* = 512 (%)	FHR changes detected by staff but not detected by mothers *n* = 389 (%)	Total FHR changes detected by mothers and by staff *n* = 901 (%)	FHR changes detected by staff *n* = 533 (%)		
1	2	3	4	5	6	7
Lateral tilt	281 (54.88)	162 (41.65)	443 (49.17)	192 (36.02)	< 0.001	< 0.001
Additional inspired oxygen	69 (13.48)	32 (8.23)	101 (11.21)	24 (4.50)	0.018	< 0.001
Intravenous fluids	84 (16. 41)	100 (25.71)	184 (20.42)	46 (8.63)	0.001	< 0.001
Oxytocin stopped	33 (6.45)	39 (10.03)	72 (7.99)	30 (5.63)	0.066	0.115
Tocolytics	1 (0.20)	0	1 (0.11)	1 (0.19)	0.890	0.722
Postnatal findings						
Resuscitation	44 (8.59)	38 (9.77)	82 (9.10)	88 (16.51)	0.624	< 0.001
Apgar scores < 4 at 5 min	0	2 (0.51)	2 (0.22)	3 (0.56)	0.363	0.001
Apgar scores < 7 at 5 min	12 (2.34)	25 (6.43)	37 (4.11)	35 (6.57)	0.004	0.053
NICU admission	39 (7.62)	36 (9.25)	75 (8.32)	71 (13.32)	0.448	0.003
Birth asphyxia markers						
HIE	9 (1.76)	11 (2.83)	20 (2.22)	14 (2.63)	0.394	0.757
Seizures	3 (0.59)	5 (1.29)	8 (0.89)	4 (0.75)	0.453	0.981
Intrapartum stillbirths*	4 1 = 27 weeks 2 = 40 weeks 3 = 24 weeks, PROM, chorioamnionitis 4 = 34 weeks, multiple birth	1 29 weeks, placenta praevia	5	4 1 = 39 weeks, abruption. 2 = 32 weeks 3 = 30 weeks, abruption 4 = 34 weeks, multiple birth		
Early Neonatal Death*	1 39 weeks, chronic hypertension	0	1 39 weeks, chronic hypertension	1 36 weeks		

Data is presented as numbers of cases or (%) if not otherwise indicated

* Individual number of cases are presented

Caesarean sections for fetal distress alone and without medical or obstetric complications for term pregnancies (purely for fetal distress as a reason) were less often reported in the joint monitored group (34.74% vs. 50.47%, $p < 0.001$), whereas operative vaginal deliveries purely for fetal distress were undertaken more often (18.98 vs. 9.57, $p < 0.001$). Actually, 63.34% of caesarean sections in the jointly monitored group and 62.9% in the medical staff alone monitored group were related purely to fetal distress. In the jointly monitored group 74.67% and in the group monitored only by staff 80.95% of vaginal operated deliveries were undertaken purely for fetal distress.

Neonates from the joint maternal and staff monitoring group less often had Apgar scores below 4 at 5 min and demonstrated a tendency to have fewer Apgar scores lower than 7 at 5 min. Neonates in this group 1.8 times less frequently required resuscitation and 1.6 times less frequently were admitted to the neonatal intensive care unit as to compare to only staff monitored group.

Discussion

The data provided here shows that, despite the full-scale war in Ukraine, it remained possible for high quality perinatal health care to continue. This situation was largely due to the enormous efforts of the Ministry of Health and National Health Services of Ukraine, dedication of the doctors and nurses, the mothers and their partners, and the protection provided to hospitals by the Ukrainian armed forces, fire services, and utility staff who continued to provide essential electricity and water supplies to hospitals as well as national resources mobilization. The protected situation for the civilian population in Ukraine is in wide contrast to what is currently happening to pregnant women in other war zones such as Gaza [10, 11] or Sudan [12].

Large proportions of the donated equipment, drugs and supplies were used by the 61 hospitals who received them (See Supplemental file 2).

It was extremely encouraging to see the widespread use (on almost 10,000 patients) of portable re-chargeable ultrasound scanners during labour and delivery which is supported by international guidelines [13, 14]. Prior to the invasion, patients needing an abdominal ultrasound examination to diagnose dangerous problems during labour were required to be moved to a separate dedicated ultrasound room some distance from the labour ward. Such actions would be extremely difficult during armed conflict, or at night with limited electricity. The donated battery-operated portable scanners were particularly valuable in identifying intrauterine complications such as placenta praevia, hyperextended head in breech presentation, and the management of a second twin birth.

Of major concern in any war zone is the need for emergency hospital-based management of obstetric complications such as obstructed labour, placenta praevia and other causes of major haemorrhage both before, during, and after delivery where surgery may be the only option. However, the presence of a scar in the uterus resulting from Caesarean section in a previous pregnancy or other uterine surgery is of particular concern because of the high risk of ruptured uterus in future pregnancies which would need urgent laparotomy; extremely difficult if hospitals have been damaged by the conflict and where major displacement of pregnant women occurs. Around 8% of the 22,808 mothers in this present cohort had uterine scars from previous surgery.

A total of 412 vacuum assisted deliveries were reported in the database. Only 236 of 1180 Kiwi vacuum delivery devices were used after distribution (Supplemental files 1 and 2) within this initiative indicating that hospitals had opportunities to use existing alternative vacuum delivery systems. Furthermore, vacuum delivery was undertaken in less than 1.8% of births indicating that more support is needed to introduce this method of managing delay or fetal distress in the second stage of labour in accordance with our previous findings [15]; especially to avoid unnecessary Caesarean sections and subsequent scarring of the uterus which creates a risk for uterine rupture in a future pregnancy.

In the group with FHR changes, where mothers were not involved in fetal monitoring, 80% underwent Caesarean section and only 12% were delivered by vacuum. High caesarean section rates in this group may be related to higher frequency of medical or obstetric conditions requiring operative delivery, but when all these conditions were excluded, fetal distress remained significantly more often the reason for caesarean section among term pregnancies in the staff-only monitored group (50% versus 35%, $p < 0.001$).

Following difficulties in providing intrapartum fetal monitoring in situations where there were targeted interruptions to electricity supplies, and when warnings of impending missile attacks, staff, along with women in labour, often needed to move to shelters. Therefore, the introduction of "contraction-by-contraction" auscultation by mothers, and their partners, during labour was widely accepted and appreciated in parallel with existing FHR monitoring by trained maternity staff.

This approach to maternal FHR monitoring is similar to a program introduced in Liberia [5, 6] and confirms that mothers in Ukraine can correctly identify around 87% of changes in FHR. Also, mothers can undertake monitoring more frequently than the 15–30-minute intervals recommended by WHO, namely after the end of every uterine contraction, which may lead in some cases to earlier detection of complications, timely corresponding interventions, and better outcome both for mothers and for neonates.

Our data suggest that cases with FHR changes which were identified jointly by mothers and staff, were possibly recognized at an earlier stage because every uterine contraction was monitored. Simple actions were undertaken more frequently to address FHR disturbance, and spontaneous vaginal and assisted vaginal deliveries were used more frequently and Caesarean Section less frequently in the jointly monitored group (Table 4). In this jointly monitored group, neonates less often required resuscitation and admission to a neonatal unit, as well as less frequently having Apgar score lower than four at five minutes. These neonatal figures need to be interpreted with considerable caution as preterm birth was less frequently present in this group compared with those where mothers were not monitoring. One reason for a less frequent preterm gestation in the jointly monitored group may have been that mothers admitted in preterm labour may have accepted the option of self-monitoring less frequently. On the other hand, staff might not propose them to participate in self-monitoring more often in cases of preterm delivery.

More frequent low Apgar score at five minutes in the group monitored only by the staff may also reflect the higher proportion of preterm infants in that group. Apgar scores at five minutes provide useful information for the survival and long-term outcome of preterm infants [16].

There were insufficient data available to analyse perinatal death indicators.

Our findings indicate that FHR changes recognised either by mother or by staff in cases where women and their partners were involved in fetal health surveillance, may help to make delivery safer for the mother and therefore for the baby as complications were probably earlier recognized. Moreover, some control over their fetal condition during delivery by mothers and their partners might have encouraged staff to more promptly apply simple actions to overcome FHR disturbances and at the same time discourage staff from undertaking unnecessary Caesarean sections. Other benefits for mothers included constant knowledge that their baby was alive and hopefully more motivation to cope with labouring and delivering their baby in an unsafe situation caused by armed conflict and, in many cases in the absence of their partner.

It was encouraging that over 80% of those changes in FHR rhythm identified by mothers immediately following the end of a uterine contraction were confirmed by staff and leading to clinical diagnosis and actions including Caesarean section or vacuum delivery to expedite delivery to minimise the risk of maternal and newborn complications.

The strength of this program is that the 61 hospitals involved were situated all over Ukraine. This program not only has provided humanitarian assistance, but also has developed a huge database during a continuing war. All women were able to use a battery-operated probe to monitor their baby if they wished, especially at times of restricted access to electricity. As more than 22,000 cases all over Ukraine were entered in the database, which cover approximately 19% of all deliveries over the country [17] during the programme monitoring period, we can assume that the population can, to an extent, reflect the cohort of women delivering in Ukraine between February and October 2023. Moreover, around 14,000 of women agreed to monitor their unborn babies, providing data on all these cases entered in the database. Selection bias remains a concern but the large size of the cohort involving a large number of hospitals hopefully will have minimised this potential problem.

One potential limitation relates to lack of knowledge on the proportion of all deliveries in each hospital that were entered in the database. Due to the uncontrolled nature of the program, we could not avoid the significant differences in the rate of preterm birth between the groups that preclude us from stating that the better neonatal outcomes in the groups with additional maternal monitoring were achieved due to that intervention.

We suggest that mothers and partners become more involved in monitoring their unborn babies; an approach which is particularly important in the 45 countries currently experiencing active war, including Ukraine [18]. The equipment is battery operated, inexpensive and requires little training. In the absence of a partner, it can reassure the mother that her unborn baby is "with her" and that "she is positively contributing to the chances of her baby being born alive and well". "Contraction-by-contraction" auscultation using a battery operated doppler ultrasound probe can be particularly valuable where the lack of constant electricity supplies makes CTG monitoring extremely difficult. Also, the lack of doctors and midwives due to them fleeing conflict or being killed can be helped by mothers and partners contributing to fetal surveillance. Maternal involvement in fetal heart rate monitoring has already been shown to be effective in a low-resource hospital setting without armed conflict where there are few doctors and midwives (Liberia) [5, 6].

Our findings could also indicate the value of this approach in maternity units worldwide, especially as mothers and their partners, as indicated here and in Liberia [5, 6], positively welcomed being involved in caring for their unborn babies. Future studies are needed to determine if the proposed approach (FHR monitoring provided by staff and by mother) in comparison with standard procedure (FHR monitoring provided by staff only) is associated with better outcomes for mothers and for neonates. Possible risks might include cost, environmental damage/waste disposal, misdiagnosis, delay in treatment and in some mothers increased anxiety.

However, this present form of monitoring "contraction-by-contraction" involves the response of FHR to every uterine contraction and helps the mother to work in close partnership with medical and midwifery staff. It also means that CTG monitoring, involving the need for mothers to be anchored to a bed, can be limited to follow the early identification of a FHR change with respect to the end of a contraction, given that every contraction is monitored by the mother.

Interventions such as lateral tilt, intravenous fluid boluses, cessation of oxytocin infusions where present are standard and important ways of improving placental perfusion during labour and delivery whilst awaiting emergency treatments such as Caesarean section or vacuum delivery. We recognise that the world literature has not confirmed the value or unlikely potential harm from additional maternal inspired oxygen treatment for fetal distress [19, 20] but it remains in practice in Ukraine even though not supported by the National Protocol. This means that these practices still have strong traditions and need more attention and effort to stop their use in Ukraine.

Our data shows the importance for the international community of ensuring resources to maintain adequate emergency perinatal care in war zones worldwide [21] and thereby provide positive effects on maternal and neonatal wellbeing.

Conclusion

Cases with FHR change, which were discovered by women themselves or jointly with staff and with the help of donated equipment were associated with specific treatment actions for fetal distress, more use of assisted vaginal birth, and less Caesarean sections.

These findings suggest that involvement of women and their partners in labour may help to make delivery safer for the mother, and possibly for her baby.

Overall, the data shows that despite the war in Ukraine, it remained possible for high quality perinatal health care to continue.

Abbreviations

CTG	Cardiotocography
FHR	Fetal Heart Rate
HIE	Hypoxic Ischaemic Encephalopathy
MCAI	Maternal and Childhealth Advocacy International
NICU	Neonatal Intensive Care Unit
NICE	National Institute for Health and Care Excellence
PROM	Prolonged rupture of membranes
WHO	World Health Organization

Supplementary Information

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Supplementary Material 1: Number, Equipment, drugs and medical supplies, Justification for donation

Supplementary Material 2: Donated item, number of patients, %, Comments.

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Author contributions

IM is one of the two corresponding authors along with DS who will be the lead in communicating with the Editors of this journal concerning its publication. DS wrote the initial draft of the paper and was involved in the data analysis. IM was responsible for setting up this program in Ukraine and working closely with the 61 maternity hospitals involved. Along with DS, IM was largely responsible for programming and analysing the obstetric issues described in this manuscript. IM edited the paper and was involved in the data analysis. IM worked closely with DD and DS in setting up the Memento database and the analyses produced in the Tables. DD identified and analysed the main neonatal issues described within this report. DD was responsible for the statistical analyses undertaken and edited the paper. DW was responsible for the initial processing of the Memento Database and helped edit the paper. RM was involved in writing and editing the paper along with preparing the program and providing the major logistic support needed to undertake the purchase and delivery of all aid. All 5 authors contributed to writing this manuscript. All 5 authors have read and approved the manuscript.

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Data availability

Datasets were generated during the current study but are not provided.

Declarations

Ethics approval and consent to participate

This program was primarily a humanitarian activity to enhance quality improvement of perinatal care and not a research study requiring ethics committee approval. Although written consent was obtained from all mothers undertaking fetal monitoring during their labour, this was only because this form of monitoring had not previously been used in Ukraine and therefore not included in available clinical guidelines. The Ministry of Health of Ukraine and Associations of Neonatologists and Obstetricians and Gynaecologists supported the design of the program and ethics committee approval was not considered necessary as the armed conflict had created a situation where normal perinatal care was not possible. Attached are letters from the Ukrainian Ministry of Health, The Association of Neonatologists, and the Association of Obstetricians and Gynaecologists confirming their support of this humanitarian program. The fetal heart rate monitoring by mothers was approved as a non-invasive form of management that could help staff address the lack of medical staff and damage to electrical supplies to maternity units.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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